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Fauna Using Nest Boxes in Four Timber Types in Eastern Texas

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ABSTRACT.—Occupancy of 240 nest boxes in pure pine, pine-hardwood, upland hardwood, and bottomland hardwood forests (60 boxes in each forest type) were monitored for six years on the Stephen F. Austin Experimental Forest, Nacogdoches County in eastern Texas. Three boxes were placed at twenty sites in each forest type. Initially, each site had a box with 3.2, 4.7, or 5.7 cm diameter entrance, but squirrels and woodpeckers enlarged entrances and altered diameters over time. A wide variety of birds, mammals, reptiles, amphibians, and arthropods used the nest boxes. Spiders and wasps used nest boxes more than any other faunal group. Tufted Titmice (*Parus bicolor*), Eastern Screech Owls (*Otus asio*), and Carolina Wrens (*Thryothorus ludovicianus*) were the only birds that we observed using nest boxes.

Nest boxes have been widely used over the past three decades in North America to provide nesting sites for a variety of secondary cavity-nesting birds (Dunn et al. 1975; McComb and Noble 1981; Willner et al. 1983; Toland and Elder 1987; Blem and Blem 1991; Caine and Marion 1991). Most notable have been efforts to increase populations of Eastern Bluebirds (*Sialia sialis*) (Kibler 1969; Zeleny 1976). European literature has abundant reports on the value of nest boxes to increase populations of cavity-nesting birds in forest habitats where dead trees and other sites for natural cavities have been eliminated by intensive forestry practices (MacKenzie 1949, 1952; Cohen 1963; Henze 1966; Campbell 1968; Stande 1968). The value of nest boxes to study avian biology has been known for many years (Lack 1955; Pulliainen 1977).

Most nest box studies have focused on areas where snags (standing dead trees) and natural cavities tend to be in short supply. We examined the occupancy of wooden nest boxes in four forest types in eastern Texas to evaluate how birds and other wildlife respond to artificial boxes in mature forest habitat. Our objectives were to explore differences in avian use rates by forest type and nest box entrance diameter.

Study Areas and Methods

Two-hundred-and-forty nest boxes were constructed from southern yellow pine (*Pinus* spp.) and were approximately 20 × 20 × 30 cm with a sloping roof attached to the box by hinges to facilitate examination of occupants. Boxes were constructed with 3 different entrance diameters (3.2, 4.7, and 5.7 cm; 80 boxes for each diameter). The back board of the box extended above and below the box chamber

[1] Maintained in cooperation with the College of Forestry, Stephen F. Austin State University, Nacogdoches, TX.

Table 1. Vegetation characteristics (mean ± SD) in mature stands of pure pine, pine-hardwood, upland hardwood, and bottomland hardwood forest habitat where wooden nest boxes were studied on the Stephen F. Austin Experimental Forest in eastern Texas.

Vegetation variable	Pure pine ($n = 20$)	Pine-hardwood ($n = 20$)	Upland hardwood ($n = 20$)	Bottomland hardwood ($n = 20$)
Vegetation height (m)	30.0 (3.7)	27.4 (5.5)	20.6 (2.9)	27.1 (5.3)
Pine basal area (m^2/ha)	23.5 (3.9)	22.6 (7.3)	3.8 (3.6)	0.2 (0.5)
Hardwood basal area (m^2/ha)	0.2 (0.6)	4.0 (3.2)	15.6 (3.5)	18.5 (4.8)
Tree density (#/0.04 ha)	11.5 (3.6)	18.5 (9.6)	10.1 (3.2)	14.0 (3.6)
Canopy closure (%)	73.1 (11.1)	71.2 (14.3)	69.3 (13.8)	72.5 (13.0)
Ground cover (%)	2.9 (2.8)	3.5 (2.4)	3.5 (2.7)	9.6 (6.4)
Natural snags (#/0.04 ha)	0.8 (0.8)	0.7 (0.9)	0.7 (0.8)	1.1 (1.0)

6 cm to facilitate attachment to trees. All boxes were completely submerged into a tank containing wood stain and sealer to retard decay. A wooden dowel 10–12 cm in length was placed 3 cm below box entrances as a potential perch site.

Nest box trails were established in four forest types (mature stands of pure pine, pine-hardwood, upland hardwood, and bottomland hardwood forest habitats) on the Stephen F. Austin Experimental Forest (31°29′N, 94°47′W) in southern Nacogdoches County, Texas. Dominant trees (70+ years-old) within all forest types exceeded 50 cm in diameter at breast height and stand height ranged from 20 to 30 m depending on forest type (Table 1). Each study area (forest type) was at least 25 ha in size. Each trail (one per forest type) was generally circular and approximately 1,130 m in length. Twenty box sites approximately 56 m apart were located along each trail. At each box site we nailed three nest boxes (3.2, 4.7, and 5.7 cm diameter entrances) to trees, one box per tree. Trees with boxes were >26 cm diameter at box height (3 m above the ground), were devoid of vines, and were 5–10 m apart. Box entrance orientation to the nearest cardinal direction was determined using a spinner fixed to a piece of cardboard.

We checked all nest boxes for occupants during the winter (January), spring (March–May), and late summer (August–September). All nest boxes were cleaned of nest material, hymenoptera nests, and cobwebs during February of each year in an attempt to increase their acceptability to birds. Boxes were checked once per season unless a nest was found or recent activity was evident. These boxes were revisited to confirm the identity of the occupant and check for avian nesting during the spring season. To check boxes for occupants we used a ladder and a pole with a mirror attached to the end. The pole and mirror were adjusted so that the contents of the box could be seen in the mirror as the tip of the pole lifted the lid of the nest box. Initially, boxes were checked at night and during the day during each season. Nocturnal box checks revealed no additional information during the first year of the study and were discontinued for the remainder of the project.

We measured vegetation characteristics at all nest box sites on each trail (Table 1). We measured vegetation height to the top of the crown canopy with a clinometer, pine and hardwood basal areas with a 1-factor metric prism (Avery 1967), and estimated percent canopy closure and percent ground cover with a 12 cm hollow tube (James and Shugart 1970). Live tree and snag density were measured within 0.04 ha circular plots centered on each box site.

Table 2. A 6 year cumulative total of occupants of 240 nest boxes in four forest types (UH—upland hardwood, BH—bottomland hardwood, PP—pure pine, and PH—pine hardwood) during spring, fall, and winter from 1987 to 1992 on the Stephen F. Austin Experimental Forest, Nacogdoches County, in eastern Texas.

	Cumulative total of nest boxes in which occupants were observed				
	Forest type				
Fauna	UH	BH	PP	PH	Total
Eastern Screech Owl *Otus asio*	0	0	4	0	4
Tufted Titmouse *Parus bicolor*	5	0	0	2	7
Carolina Wren *Thryothorus ludovicianus*	1	1	0	0	2
Bird subtotal	6	1	4	2	13
Virginia opossum *Didelphis virginiana*	0	1	0	0	1
Eastern gray squirrel *Sciurus carolinensis*	1	3	0	0	4
Fox squirrel *Sciurus niger*	0	0	2	6	8
Southern flying squirrel *Glaucomys volans*	8	6	11	39	64
Mice *Peromyscus* spp.	0	2	1	0	3
Mammal subtotal	9	12	14	45	80
Broad-headed skink *Eumeces laticeps*	1	0	0	0	1
Texas rat snake *Elaphe obsoleta*	0	0	0	2	2
Gray tree frog *Hyla* spp.	4	8	2	0	14
Herptile subtotal	5	8	2	2	17
Spiders Araneae	483	398	351	311	1,543
Red wasps *Polistes* spp.	251	248	331	294	1,124
Mud daubers Sphecidae	17	60	54	37	168
Roaches Blattidae	42	59	32	20	153
Ants Formicidae	3	23	1	1	28
Other arthropods	14	6	7	3	30
Arthropod subtotal	810	794	776	666	3,046
Total occupants	830	815	796	715	3,156

Results

The 240 nest boxes received minimal use by birds (Table 2). Out of a possible 4,320 chances (240 boxes × 3 seasons × 6 years) to detect avian use of the boxes, birds were observed only 13 times. Eastern Screech Owls, Tufted Titmice, and Carolina Wrens were the only avian species observed using the nest boxes. These three species are fairly abundant in forest habitats of eastern Texas. Mammals, primarily southern flying squirrels (64 boxes used), were detected more often than

birds (80 out of 4,320 chances). Gray tree frogs (14 frogs) were the most frequently observed herptile (Table 2).

Spiders and red wasps were the most commonly observed species, occurring in 1,543 and 1,124 box checks, respectively (Table 2). Mud daubers and roaches were also fairly common box occupants. Other arthropods observed inside nest boxes included bumble bees, yellow jackets, hornets, moths, termites, harvestmen, millipedes, and centipedes.

For most fauna, there appeared to be very little difference in box use among forest types (Table 2). Southern flying squirrels appeared to make use of boxes to a greater extent in the pine-hardwood type than in other forest types. We did not compare avian use of boxes with different entrance sizes or forest types because so few birds were detected and because squirrels and woodpeckers quickly modified box entrance diameters on approximately 30 of the boxes.

Discussion

The utility of nest boxes for common species of birds within mature forests of eastern Texas appears to be low. Our mature forest study areas were not intensively managed and contained a substantial number of dead trees (Table 1). These snags usually contained cavities excavated by woodpeckers and likely provided habitat for many of the secondary cavity-nesting birds that were present. The nest boxes appeared to be very acceptable to red wasps and spiders as they were rapidly occupied by these arthropods.

Relative to cost, the overall value of our nest box effort for cavity-nesting birds was minimal. Materials and labor for each nest box plus installation costs totaled approximately $6.00. Thus, the initial cost for the creation of all four nest box trails was approximately $1,440. This cost does not include annual checking and cleaning of boxes nor trail maintenance. By the end of the sixth year of the study, many nest boxes were beginning to show signs of decay. Several boxes had to be replaced during the fifth year because of damage caused by falling limbs.

Use of nest boxes in forest stands where natural cavities are absent or limiting still has potential value for secondary cavity-nesting birds. Nest boxes are often used by secondary cavity nesters in regenerating pine plantations following clear-cutting (MacKenzie 1952; Dunn et al. 1975; Caine and Marion 1991). American Kestrels (*Falco sparverius*) and swallows benefit from the addition of nest boxes if natural cavity sites are limiting (Hammerstrom et al. 1973; Holroyd 1975). Rare species that are cavity nesters may benefit from nest boxes even if cavities are relatively abundant in mature forests. Occasional use of a nest box by a rare species may yield significant benefits to the population. The use of nest boxes as a possible means to provide nest sites for birds and mammals that compete with Red-cockaded Woodpeckers (*Picoides borealis*) for cavities in mature pine habitat has the potential to be beneficial to the endangered woodpecker and needs investigation (Rudolph et al. 1990).

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Neotropic Cormorant (*Phalacrocorax brasilianus*) Population Trends and Dynamics in Texas

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ABSTRACT.—This study analyzes range expansion, population trends, reproductive success, band recoveries, and sightings of color-marked Neotropic Cormorants (*Phalacrocorax brasilianus*) in Texas. After a drastic population decline in coastal breeding colonies in the 1960s, they have established new coastal and inland colonies since 1973. Their population fluctuates; but, is steadily increasing. Breeding success in inland colonies may be higher than in coastal colonies because of fewer adverse factors. Although band recoveries and sightings of color-marked birds are few, post-breeding dispersal of juveniles is apparently not far from the natal colony. Southward fall/winter movement may occur. Sightings of marked birds establish that sexual maturity is reached at about 1 year of age. *Key words:* Neotropic Cormorant; *Phalacrocorax brasilianus*; range expansion; population trends; reproductive success; band recoveries; color-markers.

Introduction

The Neotropic Cormorant (*Phalacrocorax brasilianus*), formerly Olivaceous Cormorant (*P. olivaceus*), is the only cormorant inhabiting the entire tropical American region. Its range extends from Tierra del Fuego to the southern United States. In the U.S., it breeds only in southern New Mexico (Hundertmark 1974), coastal to north central Texas (Zinn 1977; Telfair 1980), and coastal southwest Louisiana (Clapp et al. 1982). The U.S. winter range is primarily along the Texas coast and extreme lower portion of the Rio Grande valley (Root 1988). Neotropic Cormorants have been recorded as rare non-breeders, winter-residents, and vagrants in 12 states: California, Nevada, Colorado, South Dakota, Minnesota, Arizona, Nebraska, Kansas, Oklahoma, Illinois, Tennessee, and Mississippi (DeSante and Pyle 1986; Nat'l Audubon Soc. 1955–1970, 1971–1994).

During the 1960s, the Neotropic Cormorant population declined drastically in Texas, perhaps in response to coastal development (Oberholser 1974) and persistent pesticides (King 1989). Since 1970, its population has fluctuated annually, but has steadily increased in numbers, and number and size of breeding colonies; and, inland colonies have been established, some quite distant from the coast (Morrison and Slack 1977; Zinn 1977; Telfair 1980; Nat'l Audubon Soc. 1980–1994; Morrison et al. 1983; Telfair and Morrison 1995).

Methods and Materials

Study Sites

This study involved banding and color-marking Neotropic Cormorant chicks at Bird Island and Telfair Island, 2 inland wooded island colonies at Cedar Creek Islands Wildlife Management Area (Cedar Creek Reservoir, Henderson County).

Several criteria were used in the choice of these sites: 1) new, annually expanding breeding colonies, 2) accessibility of nests, 3) visibility of the colony floors to allow location of marked dead chicks, 4) visibility of marked adults, and 5) accessibility to a base of operations.

Banding and Color-Marking

Banding also involved marking chicks with colored leg tags (Frentress 1975; Telfair 1993) and sequentially numbered plastic bandettes. The leg tags were made of Herculite "80", Herculite "AFC", and Wriscolux, all of which may remain intact for 3–4 years with little fading. A frayed tag was observed on a Neotropic Cormorant 11 years after banding; and, another one was recovered from a bird 6 years after banding.

Each tag was attached to a U.S. Fish and Wildlife Service metal, butt-end, pre-opened band that was placed around the bird's right leg above the foot. Different colors were used for subsequent years. When no more color combinations were available, the left leg was banded and tagged. Black-numbered yellow plastic bandettes were placed on the opposite leg to that bearing the colored tag.

Whenever possible, sibling groups were banded sequentially from youngest to oldest chick. Therefore, when dead banded chicks were recovered, their sibling group and rank within the brood could be determined.

Data Sources

Breeding and Winter Populations.—Colony locations and census data were obtained from National Audubon Society Surveys of Texas Wading Bird Colonies (1959, 1965, and 1972), Texas Cooperative Fish-eating Bird Surveys (1967–1976), Texas Colonial Waterbird Census, 1973–1976 (Blacklock et al. 1978), An Atlas and Census of Texas Waterbird Colonies 1973–1980 (Mullins et al. 1982), and Texas Colonial Waterbird Census Summaries (Texas Parks and Wildlife Dept./ Texas Colonial Waterbird Soc. 1981–1992). National Audubon Society reports were used to obtain additional breeding colony information as well as wintering population data from Audubon Society Christmas Bird Counts (Audubon Field Notes 1957–1970 and American Birds 1971–1994. Unlike winter counts, there are several years without inland breeding censuses—1969–1972, 1977–1978, 1980, 1985, and 1991 (Table 1). However, except for 1988, the inland population was small compared to the coastal population. Therefore, these data were used for trend analyses. Actual numbers of breeding pairs and wintering individuals were used in both trend analyses since this method was found to be valid when compared to the measure of effects from various observer efforts involving normalization of data (Morrison and Slack 1977). However, population adjustment ratios (pairs/breeding census and individuals/winter count) were also used in the trend analyses to compare actual numbers with normalized data to reduce survey bias.

Clutch/Brood Size.—Between 1981–1994, 254 nests containing chicks old enough to band were inventoried during banding operations to monitor the annual mean "minimum" clutch/brood size at the time of banding (June 8–27, median = June 13). "Minimal" clutch/brood size refers to the contents of nests at the time of banding and, thus, does not account for eggs or chicks that may have been lost

Table 1. Population Census Data of the Neotropic Cormorant in Texas (1960–1992).

	Breeding Pairs										Wintering Individuals								
	Population (P) Coastal			No. Colonies Censused (N) Inland			Ratio (R) Total				Population (P) Coastal			No. Count Sites (N) Inland			Ratio (R) Total		
Year	P	N	R	P	N	R	P	N	R	Year	P	N	R	P	N	R	P	N	R
1960	— No colonies reported									1960	1,631	6	272	1	1	1	1,632	7	233
1961										1961	55	2	27	2	1	2	57	3	19
1962										1962	66	3	22	2	1	2	68	4	17
1963										1963	45	2	22	No sightings			45	2	22
1964										1964	4	2	2	No sightings			4	2	2
1965										1965	44	7	6	No sightings			44	7	6
1966										1966	244	4	61	No sightings			244	4	61
1967	14	1	14				14	1	14	1967	14	4	3	No sightings			14	4	3
1968	100	1	100	3	1	3	103	2	51	1968	93	3	31	No sightings			93	3	31
1969	356	3	122		No census		365	3	122	1969	10	5	2	No sightings			10	5	2
1970	250	1	250		No census		250	1	250	1970	701	5	140	5	1	5	706	6	118
1971	180	2	90		No census		180	2	90	1971	161	7	23	77	2	38	238	9	26
1972	1,218	4	304		No census		1,218	4	304	1972	400	6	67	2	1	2	402	7	57
1973	910	5	182	8	2	4	918	7	131	1973	226	7	32	21	1	21	247	8	31
1974	350	2	175	28	4	7	378	6	63	1974	255	8	32	142	2	71	397	10	40
1975	413	5	83	15	3	5	428	8	53	1975	345	10	34	10	2	5	355	12	30
1976	1,005	5	201	15	3	5	1,020	8	127	1976	296	9	33	32	3	11	328	12	27
1977	353	8	44		No census		353	8	44	1977	392	15	26	93	2	46	485	17	28
1978	258	6	43		No census		258	6	43	1978	255	12	21	16	2	8	271	14	19
1979	853	7	122	229	4	57	1,082	11	98	1979	1,360	15	91	79	4	20	1,439	19	76
1980	930	7	133		No census		930	7	133	1980	432	15	29	509	4	127	941	19	49
1981	620	9	69	95	3	32	715	12	60	1981	833	16	52	165	3	55	998	19	52
1982	1,224	14	87	3	1	3	1,227	15	82	1982	602	14	43	17	6	3	619	20	31
1983	1,486	14	106	34	3	11	1,520	17	89	1983	181	15	12	157	5	31	338	20	17
1984	1,059	7	151	20	1	20	1,079	8	135	1984	309	15	21	140	5	28	449	20	22
1985	2,432	8	304		No census		2,432	8	304	1985	589	15	39	83	4	21	672	19	35
1986	850	8	106	250	4	62	1,100	12	92	1986	449	17	26	160	5	32	609	22	28
1987	3,987	13	307	518	4	129	4,505	17	265	1987	717	17	42	212	6	35	929	23	40
1988	1,284	12	107	1,167	4	292	2,451	16	153	1988	811	18	45	436	8	54	1,247	26	48
1989	1,057	16	66	280	4	70	1,337	20	67	1989	895	18	50	103	8	13	998	26	38
1990	3,876	17	228	558	5	112	4,434	22	201	1990	359	18	20	113	8	14	472	26	18
1991	1,120	8	140		No census		1,120	8	140	1991	677	18	38	304	11	28	981	29	34
1992	3,001	13	231	264	2	132	3,265	15	218	1992	1,009	21	48	283	9	31	1,292	30	43

earlier. These data were used to produce an index of reproductive trend, viz., estimated annual productivity (EAP) = number of fledglings/pair/year or ÷ 2, = number of fledglings/adult/year.

Results and Discussion

Range Expansion

The spread and current distribution of the Neotropic Cormorant in Texas (1883–1994) is illustrated in Fig 1. Until 1973, with the exception of 2 records (1936 in Colorado County and 1941 in Travis County), breeding colonies were coastal, especially on the upper coast (Oberholser 1974). In 1973, they began to establish nesting colonies in widely separated inland as well as coastal areas. Most of these colonies are associated with heronries, especially those containing Cattle Egrets (*Bubulcus ibis*).

Only 7 of 66 colonies (10.6%) have been consistently reestablished annually for more than a few years: 1 inland colony (Telfair Island, Cedar Creek Islands Wildlife Management Area, Cedar Creek Reservoir, Henderson County, since 1976) and 6 upper coastal colonies (Vingt-et-un Island, Chambers County, since 1967; Sydney Island, Orange County, 1971–1982; North Deer Island and Rollover Pass, Galveston County, since 1975 and 1981, respectively; Willow Slough, Jefferson County, since 1983; and Alexander Island, Harris County, since 1982). Furthermore, the location of colonies does not appear to have a discernable pattern, either spatially or temporally. However, their locations, especially inland, may reflect attraction to large heronries that possibly serve as conspicuous "beacons" to successful breeding colonies. These large noisy heronries may also serve as deterents to predators; thus, being a major factor leading to their attraction (Telfair 1980; Forbes 1989). Also of influence, may be the adaptive versatility of the Neotropic Cormorant to inhabit areas of diverse climates and environments (del Hoyo et al. 1992).

Population Trend Analysis

The Neotropic Cormorant is a permanent resident in Texas; but, the population moves southward to coastal areas and the lower Rio Grande valley in winter. Graphs of breeding and winter populations (1960–1992) show similar cycles, but dissimilar rates of change, amplitudes, and phases (Fig 2.). Cyclic periodicities are annual (68% of breeding trend, 75% of winter trend) and biennial (32% of breeding trend, 25% of winter trend). Dissimilaries may reflect survey bias resulting from localization and concentration of breeding pairs versus uneven dispersal of wintering individuals. Thus, breeding censuses may be more accurate and consistent than winter censuses. However, the overall trend is a steady population growth involving 2 major changes: 1) increases in total population, number of breeding colonies, and size of breeding colonies; and 2) establishment of new colonies along the coast and inland (Telfair and Morrison 1995).

The mean finite annual rate of population change (e^r) for the breeding population (pairs) was 1.95 ± 1.97, median = 0.86 (1967–1992) and for the winter population (total birds), was 3.94 ± 12.59, median = 0.92 (1960–1992). However, when the

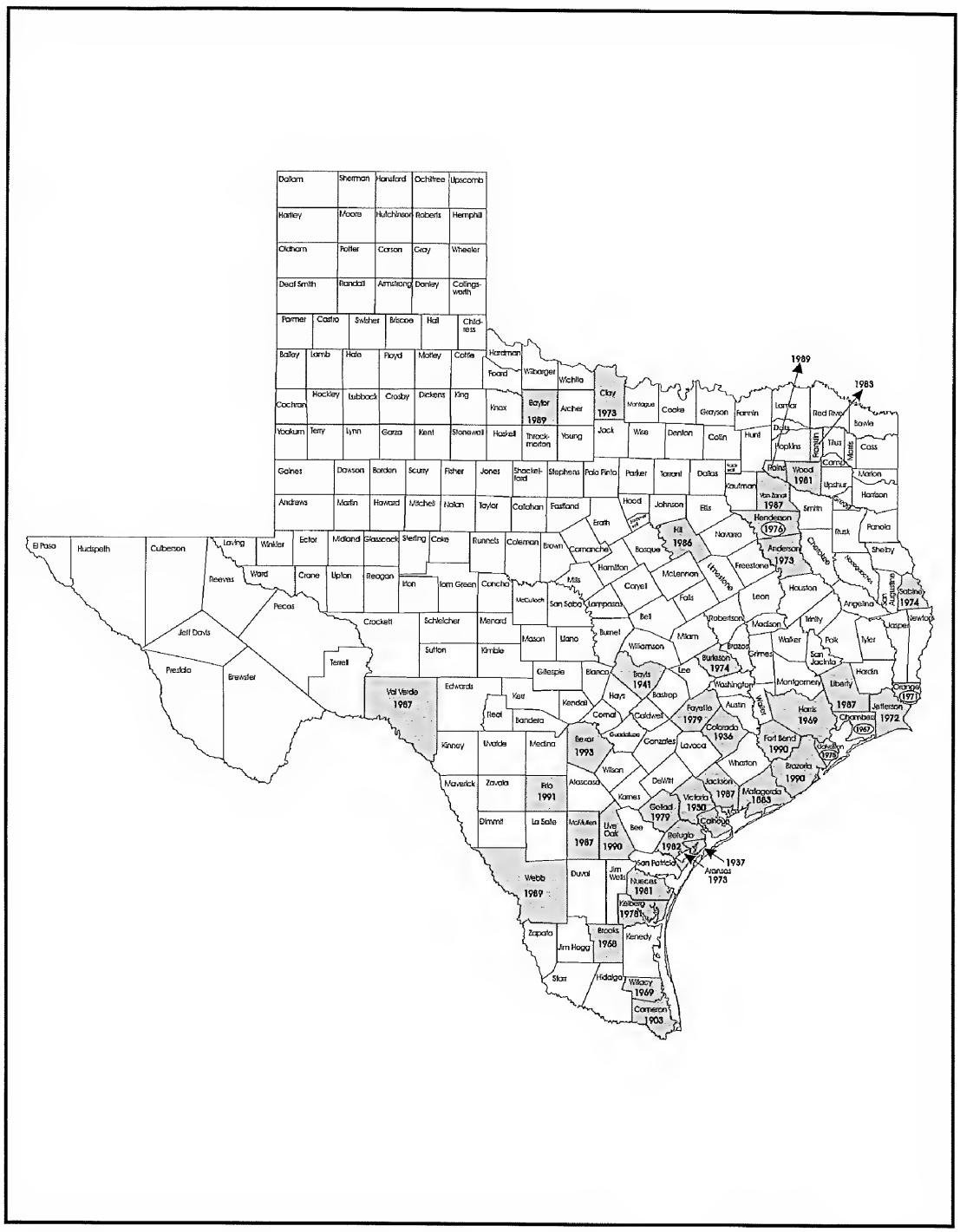

Fig. 1. Spread and current breeding distribution of Neotropic Cormorants in Texas. Spread is shown yearly by county. Only those counties encircled (Chambers, Orange, and Galveston—upper coast and Henderson—northeast inland) have consistent annually active nesting colonies since initial establishment.

data are adjusted to reflect total breeding pairs per number of colonies censused per year and total birds per number of Christmas Bird Counts/year (to reduce survey bias), the mean finite annual rates of population change are less—1.43 ± 1.03 (median = 1.22) and 3.45 ± 10.52 (median = 0.92), respectively.

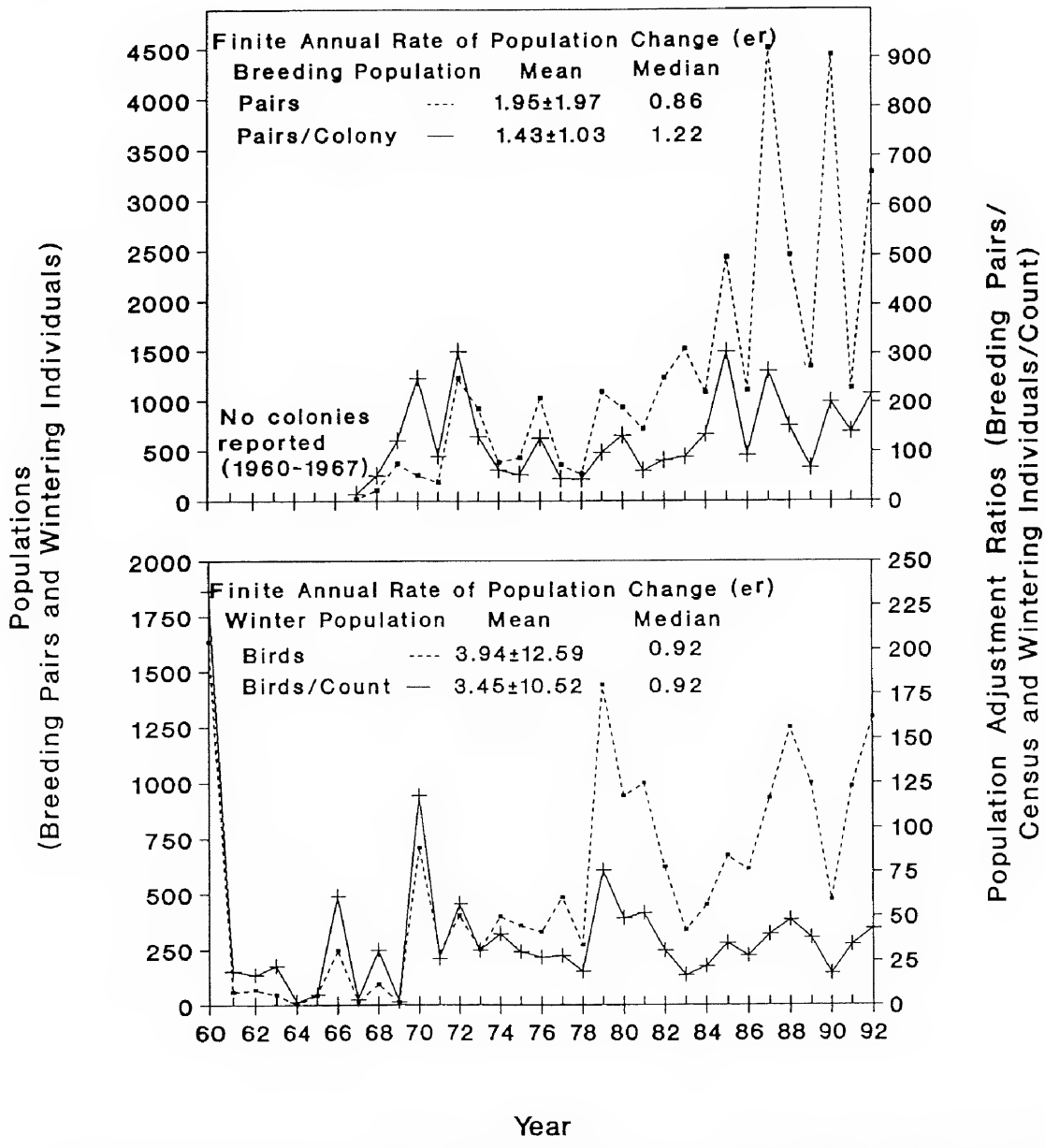
Finite Annual Rate of Population Change (er)
Breeding Population Mean Median
Pairs ---- 1.95±1.97 0.86
Pairs/Colony — 1.43±1.03 1.22
No colonies reported (1960-1967)
Finite Annual Rate of Population Change (er)
Winter Population Mean Median
Birds ---- 3.94±12.59 0.92
Birds/Count — 3.45±10.52 0.92
Populations (Breeding Pairs and Wintering Individuals)
Population Adjustment Ratios (Breeding Pairs/ Census and Wintering Individuals/Count)
Year

Fig. 2. Population trends of the Neotropic Cormorant in Texas (1960–1992). Graphs compare actual numbers (pairs and individuals) and adjustments (pairs/number of colonies censused and individuals/number of count sites) to reduce survey bias.

Reproductive Success

In general, throughout its range, reproductive parameters for the Neotropic Cormorant are: 1) mean clutch size 3–4 (range 2–6); 2) mean of 1.7 eggs hatch/nest; and 3) occasionally, 3 chicks/nest may fledge (del Hoyo et al. 1992). However, in Texas, 2 studies on the upper coast and 1 inland study provide more specific reproductive data.

In 1970, at Vingt-et-un Sanctuary (Chambers County), 250 nests fledged 600 young—2.4/nest (Oberholser 1974). In 1976, at Sydney Island (Orange County), mean clutch size was 2.99 (range 1–5) in 75 nests (Morrison 1977). At the same colony in 1977, 55 clutches ranged from 1–4 eggs, with a mean of 2.87 ± 0.72;

91 eggs (57.6% of those laid) hatched, yielding 1.65 chicks/nest; and 0.95 chicks fledged/nest, representing 0.57 chick/egg hatched and 0.33 chick/egg laid (Morrison et al. 1979).

Inland, at Cedar Creek Islands Wildlife Management Area (Henderson County), the mean brood size was 2.94 ± 0.93 with a range of 1–5 (1981–1994) as determined from 254 broods at the time of banding. This is an estimated annual productivity (EAP) of 1.47 chicks/adult, much higher than that reported from the coastal colony. Also, unlike the coastal colony, this high brood size resulted from an almost equal cluctch size (2.99 ± 0.95), i.e., most eggs (98%) hatched. Mortality among the 254 broods at the time of banding involved only 5 chicks found dead in 5 nests (0.7% of chicks, 2.0% of nests). Subsequent mortality among 1216 marked chicks was very low, 33 chicks (2.7%) from 32 nests (7.7%). Also, juvenile mortality—determined from band recoveries of the 1,190 remaining marked birds, was very low (5 birds—0.42% from 5 nests—1.23%).

As yet, too few marked chicks and flighted birds have been recovered to determine the influence, if any, of sibling hatching rank on mortality/survival within broods. However, among 20 marked chicks found dead in the colony at Cedar Creek Islands Wildlife Management Area, there were 4 1st-hatched, 3 2nd-hatched, 9 3rd-hatched, and 4 4th-hatched chicks, all but 2 (1 2nd- and 1 3rd-hatched sibling) from different nests. This sample size, though small, suggests some mortality bias toward 3rd-hatched siblings. However, among band recoveries of 7 flighted birds, 2 were 1st-, 2 2nd-, 2 3rd-, and 1 4th-hatched.

The estimated annual productivity (EAP) of 1.47 is only 2.7% more than the mean finite annual rate of population change for the breeding population (1.43) where the data reflect total breeding pairs/number of colonies censused (1967–1992). Thus, the low mortality among inland chicks and juveniles may explain the close relation between annual productivity and population increase.

Starvation and/or trampling of smallest nestlings, predation of eggs by Boat-tailed Grackles (*Quiscalus major*) resulting from effects of human disturbance of incubating birds, and loss of nests to storms were the major causes of mortality at Sydney Island (Morrison et al. 1979). Other adverse factors that affect coastal colonies are erosion and contaminants (Morrison et al. 1978; King 1989; Cain 1993). Except for a severe hail storm in early May 1993 that killed or injured many herons and egrets, but few cormorants, none of these adverse mortality factors have been noted in the Cedar Creek Reservoir colony. This may account for the difference between reproductive success. Also, coastal colonies may possibly be subject to population cycles by the climatic effects of El Niño years which affect food fish availability (Walton and Green 1993).

Band Recoveries and Sightings of Marked Birds

Only 11 (0.9%) band recoveries have been reported. But, banding in Texas did not begin until 1981 and 87.3% of banding has occurred since 1990. Ages at the time of death are known for 10 of these recoveries: less than 1 year (5), about 1 year (1), about 2 years (1), 3.4 years (1), 3.8 years (1), and about 6 years (1). There are 6 circumstances of band recoveries: shot (2); found dead (3); found dead, skeleton only (1); caught by hand, probably due to injury or parasitism (1); band only found (1); and hooked and drowned on trotline (2).

Seven of the band recoveries came from locations in Cedar Creek Reservoir

(Henderson County) where the natal colony is located; 2 recoveries came from Richland-Chambers Reservoir (Navarro County), about 25 mi. (40 km) distant; 1 recovery came from U.S. Highway 287 near Palestine (Anderson County), about 40 mi. (64 km) distant; and 1 recovery came from Fairfield Lake, about 37 mi. (59 km) distant.

Most sightings of marked birds (33 of 49 = 67.3%) involved those that returned to their natal colony to breed. Age classes are known for 31 of these birds: 15 about 1 year, 11 about 2 years, and 5 about 3 years. All were attending nests containing eggs or young; thus, establishing the first evidence that Neotropic Cormorants can reach sexual maturity at about 1 year of age (Clapp et al. 1982).

The other 14 sightings occurred during post-breeding dispersal (6), southward fall movement (1), winter (2), and spring/summer (5). The post-breeding dispersal sightings were at Richland Creek Wildlife Management Area (Navarro County), about 40 mi. (64 km) from the natal colony. Two of these birds were about 2 months old when sighted (banded when fledging—about 1 month old) and both were observed at the same location for about another month. Two birds were 2.4 months old and the other 2 were 3.8 months old. The fall sighting (early October) of a 4 month old bird occurred at a small pond near Warren Lake in Waller County. The winter sightings were at Aransas National Wildlife Refuge (Aransas County) in late February (10 month old bird) and Marlin City Park Lake (Falls County) in mid-January to early February (9 month old bird). The fall and first winter sighting were in the coastal region, about 145 and 300 mi. (233 and 483 km), respectively, south of their natal colony. The other winter sighting was inland, 79 mi. (127 km) southwest of the natal colony. Spring and early summer sightings occurred at Richland Creek Wildlife Management Area: a 10 month old bird in late March, 3 birds of unknown age in late May, and a 1 year old bird in late June.

The fall/winter sightings support the observation that few birds remain above 27°N latitude during winter (Oberholser 1974). This distribution is reflected in mean annual counts of birds per party-hour during Christmas Bird Counts (National Audubon Society 1957–58 to 1993–94)—coast/coastal prairie (0.61 ± 1.01) vs. inland (0.05 ± 0.06). The La Sal Vieja Lakes count (just west of Raymondville, Willacy County, in south Texas) recorded Neotropic Cormorants in the most years (9 of 10) and highest densities (6.46 individuals per party-hour) of all counts (Root 1988).

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SHORT COMMUNICATIONS

R. E. and J. H. Rachford, Collectors and Dealers in Birds' Skins and Eggs

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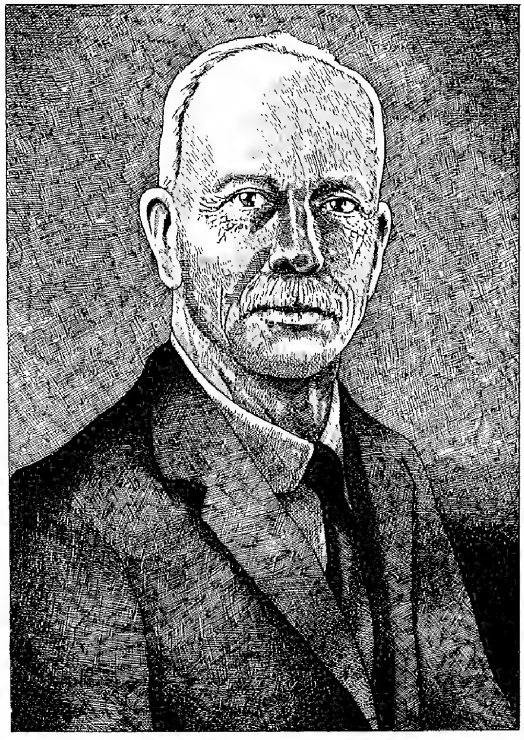
Scattered throughout the natural history journals of the 1880s and 1890s are the advertisements of several collectors and dealers in the skins and eggs of Texas birds. Two of the more important of these collectors were Robert Elija and James Henry Rachford, a father and son team who were active in Jefferson and Orange counties from March 1884 through the spring of 1889. During this period the Rachfords were the only resident collectors in this region of Texas. Specimen records or sightings attributed to the Rachfords are given for at least 44 species in Oberholser's typescript of *The Bird Life of Texas*. The typescript also lists nine ornithological notes published by the Rachfords. Most of the records credited to the Rachfords were deleted as the typescript was prepared for publication. It is therefore the purpose of this note to present what is known of the lives and ornithological contributions of these early observers.



JAMES HENRY RACHFORD
From a photograph in *The New Encyclopedia of Texas*

Robert Elija Rachford was born on 3 February 1842 in Larue County, Kentucky. He married Angie Dearing, a union to which James Henry was born on 8 September 1866. James was educated in the public schools of Glasgow, Kentucky, and in 1883 graduated from Glasgow Normal College. In that same year the family moved to Grigsby's Bluff [now Port Neches] in eastern Jefferson County, Texas (Davis and Grobe 1926).

The tax assessment rolls for 1885 show R. E. Rachford to be the owner of a cow, a hog, and miscellaneous property worth fifty dollars. However, by 1889 he was the owner of 100 acres of land. The 1900 census gives his occupation as foreman of a lumber yard. A few years before his death on 10 March 1911, he moved from Beaumont back to Port Neches where he engaged in farming (Anon. 1911).

James Rachford studied law during his first years in Jefferson County and was admitted to the bar in 1887. In that same year, he entered into the real estate business and in the following year organized the Rachford Abstract Company of Beaumont. In 1889 he married Annie C. Baughn from Brazoria County. In later years, James Rachford served at various times as county judge, county surveyor, vice-president of the Neches Transportation Company, and president of the Silsbee Oil and Development Company (Davis and Grobe 1926). He continued to be active in development and civic affairs of Beaumont until his death on 23 March 1949.

How the Rachfords became involved in the specimen trade is unknown. Their business letterhead and advertisements clearly indicate that Robert was the senior member of the partnership. The business was originally located in Grigsby's Bluff but in the September 1886 issue of *The Ornithologist and Oologist* the Rachfords gave notice that they were moving to Beaumont.

Oberholser's typescript of *The Bird Life of Texas* is the major source for specimen records and sightings by the Rachfords. Oberholser apparently extracted these records from the published works of the Rachfords, from data on museum specimens, and from personal communication. All of the birds collected by the Rachfords were taken in Jefferson and Orange counties. The earliest specimen record that I have found is for a Swamp Sparrow taken on 21 March 1884. Most of the records are for specimens (birds or eggs) collected during 1885, 1886, and 1887. The records for 1888 and 1889 are based on sightings and it would seem that by this time the Rachfords had quit actively collecting.

Nine ornithological notes were published by the Rachfords. The first of these described the death of Northern Mockingbirds, Boat-tailed Grackles, and Kill-

R. E. RACHFORD & SON,

Grigsby's Bluff, Texas.

COLLECTORS

AND WHOLESALE DEALERS IN

BIRD SKINS AND EGGS.

SEND FOR PRICE LIST.

Rachford's advertisement from *The Ornithologist and Oologist* February 1886.

deers during a freeze occuring on 8–9 January 1886 (Rachford, J. H. 1886). Other papers published in this same year dealt with the breeding of the Roseate Spoonbill and Turkey Vulture in Jefferson County (Rachford, R. E. 1886, Rachford and Son 1886a, 1886b, 1886c). In the following year a more extensive note was published on the occurrence and breeding of several species near Beaumont (Rachford and Son 1887).

In 1888 James Rachford began publishing what was to be a series of 15–20 papers on the birds of southeast Texas. The stated purpose of this series was "to awaken an interest in ornithology and oology in Texas." The articles were to be published in two Texas papers, one in Beaumont and the other in Houston (Editor 1889). The first three installments were published at Houston in the *Geological and Scientific Bulletin* (Rachford 1888–1889) and the first installment was reprinted in *The Ornithologists' and Oologists' Semi-Annual* (Rachford 1889a). The project apparently came to an end with publication of the third installment. The Beaumont papers for this period are not readily available and the publication of Rachford's articles in this source cannot be verified.

James Rachford's last paper dealt with the nesting of the Purple Gallinule on the Texas coast (Rachford 1889b). Of particular interest in this paper is a description of the "sham nests" built by gallinules in the vicinity of the nest that is actually being used.

The significance of the work of R. E. and J. H. Rachford is difficult to evaluate. Two experienced collectors working over a period of 5½ years (1884–spring 1889) could have collected hundreds of birds and sets of eggs. These specimens, when sold to customers throughout the United States, could have potentially ended up in many different museums and private collections. Since Oberholser did not find this to be the case, it must be assumed that the Rachfords did a low volume business.

Most of the birds collected by the Rachfords were common species. Their most significant find was perhaps the eggs of a Fish Crow collected in Orange County on 4 May 1886, a record that documents the earliest confirmed breeding of this species in Texas.

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Successful Nesting of the White-collared Seedeater in Zapata County, Texas

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Once widely distributed from Laredo to Brownsville and up the Texas coast to Corpus Christi, the White-collared Seedeater (*Sporophila torqueola sharpei*) is now considered rare (Oberholser 1974, Rappole and Blacklock 1994). The known Texas distribution of the species now centers around a small population near San Ignacio and Zapata in Zapata County, Texas (Ortego 1991a). Infrequent sightings of a few individuals have been recorded, in the Falcon thorn woodland (Kennard 1976), Falcon Dam Recreational Area (Arvin 1974) and nearby Fronton (Ortego 1994), in Starr County; Santa Ana National Wildlife Refuge in Hidalgo County (Ortego 1991b); Southmost Ranch in Cameron County (Leslie and Jahrsdoerfer 1988), and Webb County (Arnold 1980). The presence of "dependent young" at San Ignacio is documented in the TBBA database however no specifics are given. This note details the successful breeding of the species in Zapata County, Texas.

On 13 August 1994 at 1400 hours along the Rio Grande near San Ignacio we observed a female White-collared Seedeater feeding three recently fledged young perched in a bunch of barnyard grass (*Echinochloa crus-pavonis* (H.B.K) Schult

Fig. 1. Adult female White-collared Seedeater (bottom) with recently fledged young, in barnyard grass near San Ignacio during August of 1994. Photo by Jack Clinton Eitniear.

var. *macera*)(Lonard 1993). The sighting occurred in the river floodplain habitat (Lonard et al. 1991) of the Fauzal-Fresno Association (Kennard 1976) in the Tamaulipan Biotic Province (Dice 1943, Blair 1950). The young birds were identified by the dark buff wing coverts and "begging call" with an accompanying "wing quivering behavior". Subsequent to the observation, two of the young were captured, in mist-nets and banded (Right leg USFWS band #840-139-02, Left leg auxiliary Green colored band; Right leg USFWS band #840-139-03, Left leg auxiliary Yellow colored band). Previous records of reproduction include eggs collected in Brownsville in 1946 (Freidmann 1963, Friedmann and Kiff 1989), near Santa Maria, Hidalgo County in 1937 (Bent 1968), and in the Rio Grande Valley by Ford in 1938 (Bent 1968). Oberholser (1974) noted the precipitous decline in the species in the mid-1960s and stated that the species had been collected in adjacent Starr and Webb Counties but "nesting has not been documented".

Skutch (1954) indicated that the young birds leave the nest 10 to 11 days after hatching. Additionally, Irby Davis (*in* Bent 1968) recorded dates of 12 June for hatching, and fledging on 20 June (8 days). Considering this, and with no observation of fledglings on a previous visit of 30 July, the hatch date of the observed birds was likely within the first week of August. This breeding is the first recorded for Zapata County and the first documented successful nesting of the species in Texas since 1946.

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Patrick Duffy and His Collection of Birds from Fort Stockton, Texas

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Patrick Duffy was sent to Fort Stockton in February 1860 to collect natural history specimens for Spencer Baird at the Smithsonian Institution. Although Duffy left Texas in March 1861, several of his specimens were acquired by Henry Eeles Dresser during his visit to Texas in 1863–1864. Adding to this confusion, some of the birds taken by Duffy are credited by Oberholser (1974) as having been collected in 1862, 1863, and even as late as 1864. It is thus the purpose of this note to provide a chronology of the collecting activities of Patrick Duffy and an explanation of how his Fort Stockton specimens might have been obtained by H. E. Dresser.

Early Life and Military Career

Patrick Duffy was born about 1830 in Roscommon, Ireland, and immigrated to America at an early age. On 12 June 1849, he enlisted at Albany, New York, for his first five-year term of service in the United States Army. In December 1849, he was sent to Camp San Elizario on the Rio Grande below El Paso where he served as the hospital steward until September 1850. From October 1850 through September 1851, he was stationed at Paso del Norte, Texas, and later at various locations in New Mexico. Following his discharge, Duffy returned to New York where he re-enlisted on 23 August 1854. He was discharged from this term of service at Camp Van Camp in Young County, Texas, in August 1859.

In November 1859, Duffy re-enlisted for his third term of service and in February 1860 was assigned to Fort [then Camp] Stockton. Duffy's transfer to Fort Stockton was arranged by Spencer Baird of the Smithsonian as part of his strategy of using army medical personnel to obtain specimens from military posts in the western United States.

Collections Made at Fort Stockton

Fort Stockton was established in March 1859 where the road from San Antonio to El Paso passed near Comanche Springs. The springs gave rise to Comanche Creek which supported an extensive growth of marsh vegetation before the water disappeared into the sand about 25 kilometers downstream (Brune 1981). Although many early observers commented on the abundance of waterfowl and fish, Duffy (1860c) believed the area to be a "poor place for collecting" because of the "absence of timber and the barren, dry, and salty soil."

Duffy was sent to Fort Stockton with inadequate supplies for collecting, only a vague idea of what he should collect, and no instructions on how to ship his specimens to the Smithsonian. On April 7th, he informed Baird that he had collected some "plants & flowers" and a "few birds" and would continue to collect while awaiting further instructions (Duffy 1860a). Baird responded in early May

with details on the specimens he would like to obtain, as well as arranging for cotton and arsenic to be sent from San Antonio. The question of reimbursement for supplies was, however, unresolved and Duffy made a special note of the high price of the shot that he was forced to purchase from his meager salary as hospital steward (Duffy 1860b).

Duffy's first shipment of specimens, sent by quartermaster train on June 29th, consisted of three boxes containing the skins of 54 birds, two eggs of the Crested Caracara, two eggs of the Greater Roadrunner, two preserved rattlesnakes, the skins of three muskrats, two squirrels, two pocket gophers, two rabbits, and 22 specimens of fossils (Duffy 1860c). Three of the birds in this shipment, labeled as "Brown Snipe," were later determined to be Eskimo Curlew. These curlews, collected during the first week in May, were the first of their species to be collected in Texas (Oberholser 1974).

Duffy's second shipment, sent by overland mail on July 22nd, consisted of single eggs of the "blue or top knot quail" and the "grey or Mexican quail," as well as two eggs of an unidentified dove. Duffy also indicated at this time that he would prefer a transfer to a part of the country where the prospects for collecting would be better (Duffy 1860c). Baird then used his influence with Dr. Richard Coolidge who, in turn, wrote in mid-December to Dr. E. H. Abadie, Medical Director of the Department of Texas, asking that Duffy be transferred to Camp Hudson on the Devil's River. In his letter, Coolidge described Duffy as being "an industrious naturalist" and a "good taxidermist" (Geiser 1958).

On 19 January 1861, Duffy informed Baird that he would be transferred to Camp Hudson about the first of February. He also wrote that he had a few specimens that he would box and "send in a few days" (Duffy 1861a). Soon after, writing from Camp Hudson, Duffy said he was "well pleased with the change," and he hoped to collect a "good harvest" of specimens during the summer (Duffy 1861b). This expectation was, however, shattered by the news received in early March that all federal forces were to be removed from Texas as soon as possible (Duffy 1861c). On March 17th, Camp Hudson was evacuated. Duffy and his unit joined other federal troops on their march to Indianola where they boarded ships bound for New York City. All of the collecting supplies at Camp Hudson were left behind since there was no means for their transportation (Duffy 1861c).

Once in New York, Duffy informed Baird that a box of birds, the last to be collected at Fort Stockton, had been sent to the Smithsonian during the latter part of February. Duffy had, however, lost his copy of the list of birds in the shipment while camped on the Texas coast awaiting evacuation. Although hopeful of seeing active duty during the Civil War, Duffy indicated he would gladly serve as a collector at any frontier fort where Baird might arrange to have him placed (Duffy 1861d).

Activities During The Civil War

Patrick Duffy never returned to the frontier. In January 1862, he was reimbursed by the Smithsonian for expenses incurred while collecting in Texas (Duffy 1862). He continued to serve as a hospital steward and on 22 July 1862 married Jane Bernard in Washington, D.C. On 20 February 1864, he re-enlisted for a three-year term of service. His only child, Mary Jane, was born on 31 July 1865. A few

weeks later he was discharged because of illness. Patrick Duffy died of tuberculosis in Washington, D.C., on 26 December 1866.

Fort Stockton Specimens Obtained by Dresser

How the English ornithologist Henry Eeles Dresser obtained specimens collected by Patrick Duffy is a mystery. Dresser arrived at Matamoros, Mexico, on 26 June 1863 and spent the next thirteen months collecting in southern Texas while conducting business with officials of the Confederate Government. The published record of his observations includes references to 21 specimens of 18 species collected at Fort Stockton by Patrick Duffy. These specimens were sent to Dresser by a certain "Col. McCormick" who was not specifically identified (Dresser 1865, 1866).

The specimens in question are presumably those collected during the latter part of 1860 that Duffy promised Baird on 19 January 1861 that he would "send in a few days." The specimens were instead taken to Camp Hudson where they were finally shipped during the last part of February. There is no record of their receipt by the Smithsonian, and it might be assumed that they were confiscated by the confederate authorities who later gave them to Dresser. Although logical, this scenario does not account for the mysterious "Col. McCormick" from whom Dresser obtained the specimens. An intensive search of the confederate military records has shown that no "Col. McCormick" ever served in Texas. If he was not a confederate, then "Col. McCormick" must have been a federal officer, possibly Brevet Col. Charles McCormick, M.D., from Washington, D. C.

After leaving Texas in July 1864, Dresser sailed for England via New York City. Charles McCormick was at this time on a leave of absence to his home in Washington. Dresser disembarked at New York and then traveled to Washington where he visited with members of the Howard family whose southern relatives had befriended him during his stay in San Antonio (Dresser 1864). There is some evidence that the Howard and McCormick familes were intermarried, and it is possible that Dresser met Charles McCormick at this time. If indeed this is the correct "Col. McCormick," it is still a mystery how McCormick would have obtained the specimens and why they were given to Dresser rather than being forwarded to the Smithsonian.

Incorrect Collection Dates

The specific dates on which Duffy collected the Fort Stockton specimens obtained by Dresser are unknown. However, since Patrick Duffy left Fort Stockton in February 1861, the dates given by Oberholser (1974) for collection of the Bufflehead (circa 1862), Common Merganser (circa 1862), Roseate Spoonbill (1863), and Wood Duck (1864) are obviously incorrect.

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NOTES AND NEWS

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